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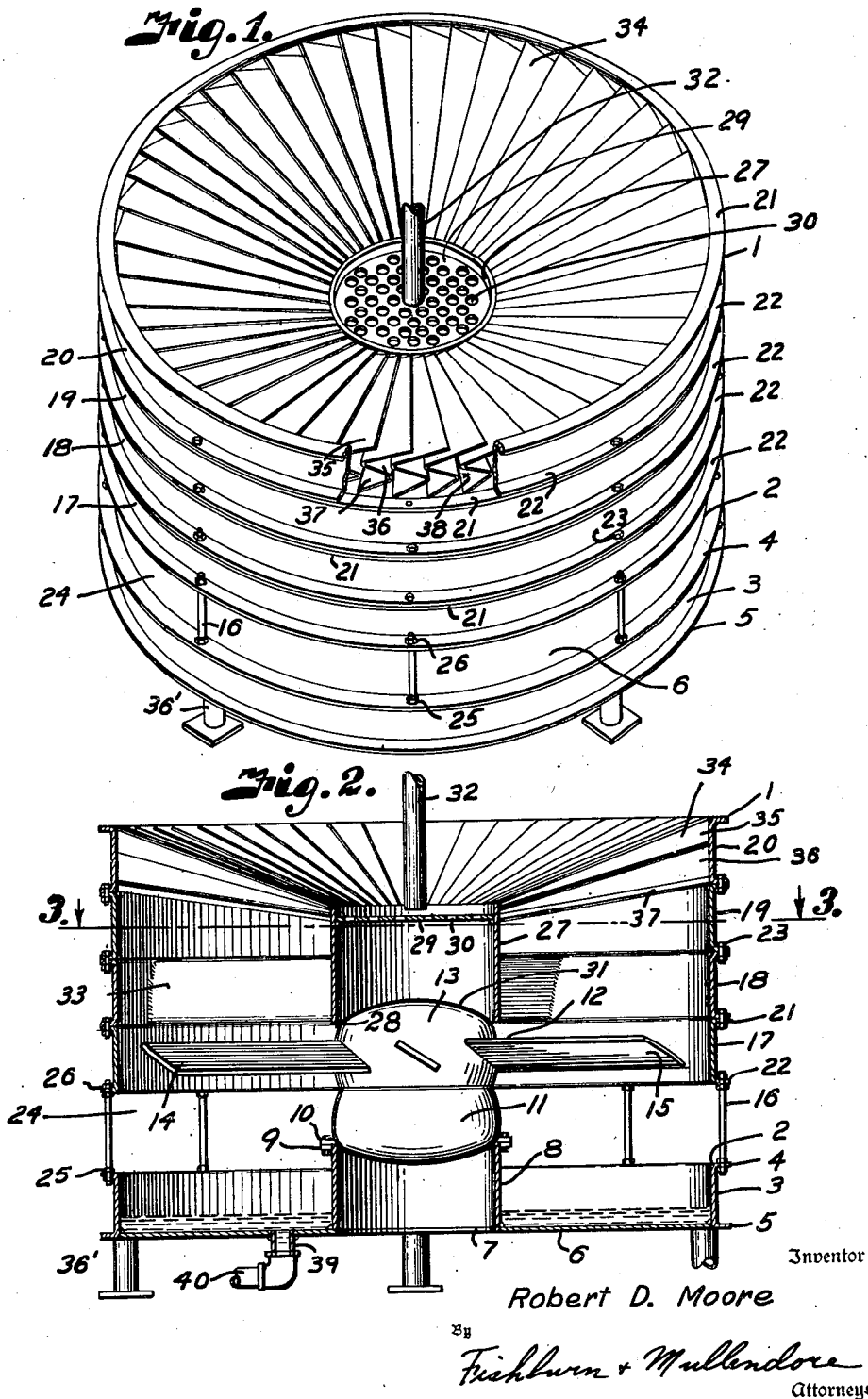
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2,596,782

APPARATUS FOR COOLING LIQUIDS

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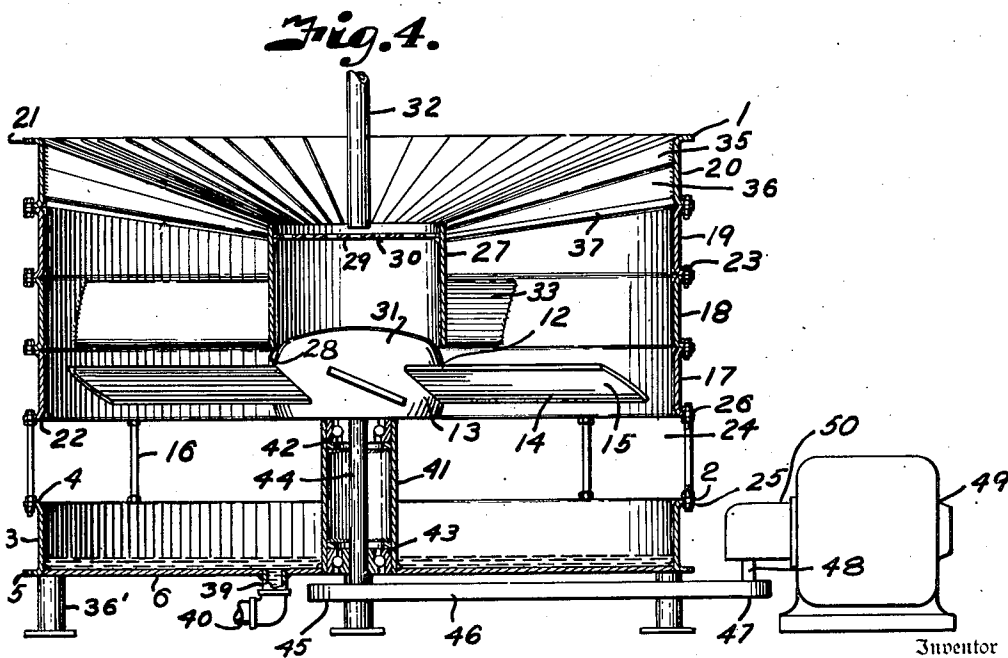
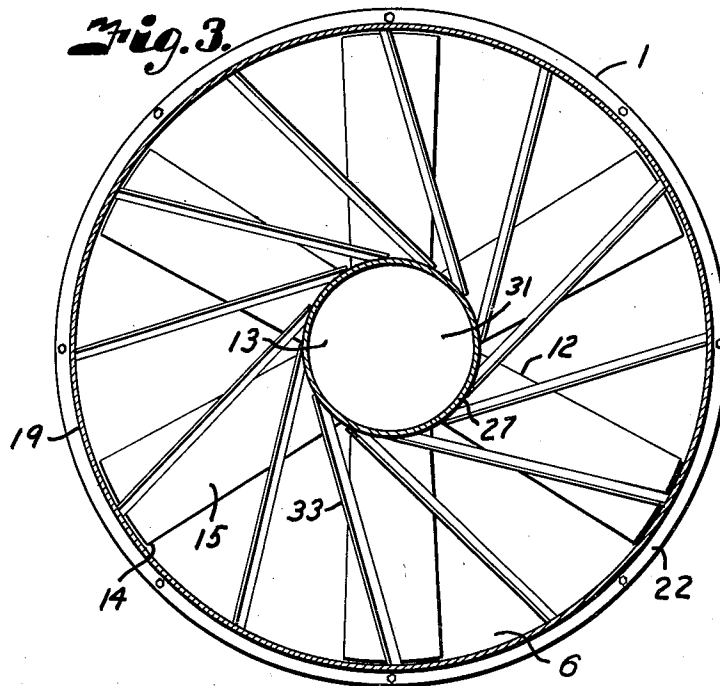
2 SHEETS—SHEET 1



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APPARATUS FOR COOLING LIQUIDS

2 SHEETS--SHEET 2



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APPARATUS FOR COOLING LIQUIDS

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1 Claim. (Cl. 261—30)

1

This invention relates to an apparatus for cooling a liquid by contacting droplets of the liquid with an air stream. Apparatus of this character usually involves counterflow of the air and is of great height to obtain the required contact time between the air and droplets of liquid without too high a velocity of the air. Consequently, the contacting apparatuses as heretofore constructed occupy large areas which are not always available. They are also very expensive and must be shipped knocked down and erected on the site.

Therefore the principal objects of the present invention are to provide a small compact cooling apparatus that may be shipped as a unit, and to provide a cooling apparatus having a structure to effect contact between the droplets of liquid and air by providing means for imparting an upward velocity to the liquid droplets which carries them in concurrent flow with the air until the imparted velocity is expended whereupon the droplets fall in counterflow through the air stream to again receive a reverse upward velocity and the process is repeated until the droplets are able to drop below the velocity imparting means.

Other objects of the invention are to utilize the air impelling means as the means for imparting the reverse velocity to the droplets of liquid; to provide a liquid cooling apparatus whereby any desired capacity may be obtained by superimposing cooling units one above another; to provide a cooling unit with means for effecting return of the liquid droplets to the impelling means; to provide the cooling unit with a mist extractor for removing liquid spray from the air discharged from the unit; and to provide a cooling unit with an impelling means which may be driven by a directly connected motor or from a driving connection with a prime mover located outside of the unit.

In accomplishing these and other objects of the invention I have provided improved structure, the preferred forms of which are illustrated in the accompanying drawings wherein:

Fig. 1 is a perspective view of a liquid cooling unit constructed in accordance with the present invention.

Fig. 2 is a vertical section through the unit equipped with a propeller having a direct drive.

Fig. 3 is a horizontal section on the line 3—3 of Fig. 2.

Fig. 4 is a vertical section through a unit equipped with an impeller actuated through a driving connection with a motor located exteriorly of the unit.

2

Referring more in detail to the drawings:

1 designates a liquid cooling unit constructed in accordance with the present invention and which includes a pan 2 having an annular wall 3 provided at its upper and lower edges with out-turned circumferential flanges 4 and 5. Fixed to the wall 3 substantially in plane with the flange 5 is a bottom 6 having an axial opening 7 encircled by a motor supporting tube 8 which is suitably connected with the bottom to provide a leak-tight connection. The tube extends above the wall of the pan and has laterally directed ears 9 for attaching ears 10 of a motor enclosed within a housing designated 11. Supported by the housing 11 is an impeller 12 including a housing-shaped hub 13 that cooperates with the housing 11 in enclosing the motor. Projecting radially from the impeller hub 13 are blades 14. The blades 14 are relatively flat and wide to provide large impelling surfaces 15 on their upper sides.

Supported on rods 16 carried by the upper flange 4 of the pan 2 is a series of rings 17, 18, 19 and 20 superimposed one upon another and having outturned flanges 21 and 22 extending circumferentially of their upper and lower edges for securing the sections together, fastening devices such as bolts 23 being extended through registering openings in the abutting flanges as shown in Fig. 2. The lowermost ring is thus spaced above the upper edge of the pan wall 3 to provide an annular inlet 24 for flow of air into the bottom of the housing incidental to operation of the impeller. The spacing rods 16 have their lower ends secured to the upper flange 4 of the pan and their upper ends secured to the flange 22 of the lower ring of the housing as indicated at 25 and 26 respectively.

The lower ring 17 encircles the impeller blades and next upper ring 18 supports a liquid dispersing cylinder 27 of slightly larger diameter than the impeller hub 13 to provide an annular outlet 28 therebetween for discharge of liquid to be cooled onto the surfaces 15 of the impeller blades as later described. The upper end of the cylinder terminates short of the upper ring 20 and carries an inset diaphragm 29 provided with a plurality of apertures 30 for diffusing the liquid to be cooled and causing it to fall in droplets over the upper curved surface 31 of the impeller hub which throws the droplets through the outlet 28 onto the blades by centrifugal action.

The liquid is discharged onto the diffusing diaphragm 29 from a supply pipe 32 that leads from the source of supply (not shown).

3

The cylinder 27 is supported by vanes 33 that extend radially therefrom and have their outer ends attached to the ring 18. The vanes have the sides thereof in planes of near right angles to the fan for effecting change in the directional flow of the air from a spiral direction to an axial direction.

Extending from the upper edge of the liquid inlet cylinder 27 and connected with the upper ring 20 is a plurality of sector-shaped baffles 34 having zigzag-shaped portions 35, 36 and 37 arranged in spaced relation with the corresponding portions of the adjacent baffles to provide tortuous passageways 38 for the outlet of air from the upper end of the housing to eliminate discharge of spray with the air.

The pan 2 may be supported on legs 36' and has an outlet 39 in connection with a return duct 40 for the cooled liquid.

The form of the invention shown in Fig. 4 is substantially the same as that illustrated in Fig. 2 with the exception that the tubular support 41 for the impeller is of smaller diameter and carries anti-friction bearings 42 and 43 journaling a vertical shaft 44 that carries the impeller. The shaft extends below the bottom of the pan and carries a pulley 45 that is driven by a belt 46 from a pulley 47 that is connected with the power shaft 48 of a motor 49 having a reduction gearing indicated by the housing 50.

The cooling unit thus described may be assembled in the factory and shipped in assembled condition to the place of use.

In installing the unit the liquid supply and return ducts 32 and 40 are connected with liquid source so that the hot liquid is delivered to the unit through the duct 32 and returned through the duct 40. The motor of the impeller 12 is connected to a source of current supply to complete the installation.

In operating the unit, the motor is energized to rotate the impeller so as to draw air through the annular opening 24 and discharge the air at substantial velocity upwardly through the cylindrical housing-like rings 17, 18 and 19 for discharge through the tortuous passageways 38 provided between the mist eliminator baffles 34. Liquid to be cooled is discharged from the duct 32 so that it flows over the diffusing diaphragm 29 and drops through the apertures 30 onto the crown surface 31 of the impeller hub 13 which splatters the droplets and under centrifugal action discharges the splattering droplets through the outlet 28 into the path of the impeller blades and across the air flow to cause the droplets to collide with the fan blades and have imparted thereto an upward velocity. The droplets thus move upwardly through the housing in concurrent flow with the air until they lose the imparted energy through change in direction of the air flow by the guide vanes 33 whereupon they fall at relatively slow rate through the air stream to again be contacted by the blades which again impart the upward velocity of the droplets in concurrent flow with the air stream. The process is thus continued many times until the droplets finally miss the impeller blades and drop across the air inlet opening into the collection pan where the cool liquid accumulates and is discharged through the return duct 40. The guide vanes 33 being located over the impellers

4

and in the path of the air moved thereby straighten out and prevent spiraling of the air so that the air and droplets move upwardly in axial flow through the cooling space. Thus, the droplets are broken up by the repeated action of the impeller blade and are kept in continuous contact with freshly moving air to assure the highest efficiency. It is obvious that any mist entrained with the air passing through the tortuous passageway is caused to drop out and be returned to the cooling space.

From the foregoing it is obvious that I have provided a cooling unit of small compact construction and which maintains sufficient contact time between the droplets of liquid and a continuously moving flow of air to reduce the temperature of the liquid to the required degree.

To treat greater volumes of liquid additional units may be installed one above the other with the mist extractor located on the uppermost unit.

What I claim and desire to secure by Letters Patent is:

A device for cooling a liquid including a housing composed of a plurality of superimposed ring members having circumferential flanges at opposite edges with the flanges at one ring seated upon the flange of an adjacent ring, means connecting the flanges together with the uppermost ring forming an outlet, a liquid collecting pan below said housing, means supporting the lowermost ring of said housing in spaced relation above the pan to provide an annular air inlet, an impeller mounted within a lower ring and having blades projecting from a hub having a crowned upper surface above the blades and curving downwardly toward said blades, air guide vanes in an upper ring, means for supporting the impeller in said lower ring with the blades rotatable horizontally above the annular inlet and below the guide vanes for drawing air through the inlet and moving air upwardly for discharge through the outlet, a tube of slightly larger diameter than the hub and having support by the air guide vanes over said hub, means for delivering a liquid through said tube for distribution in small streams over the crowned surface of the hub for circumferential discharge from the crowned surface and into collision with the blades to impart velocity to the droplets of the liquid and maintain the droplets in motion with the air until the droplets lose the imparted velocity and drop in counterflow with the air between the impeller blades and into the water collecting pan.

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